

Pterocymbium tinctorium (Merrill, 1901) (Magnoliophyta: Malvales: Sterculiaceae: Sterculioideae): New record from mainland India and extension of geographic distribution

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ABSTRACT: We present a new record of the winged-boot tree (*Pterocymbium tinctorium*) discovered in the Khasi Hills of Meghalaya on the Indian mainland. With this record, the known geographical distribution of *P. tinctorium* is now extended up to the foothills of the Eastern Himalayas in Southeast Asia. The species was recorded from the tropical moist deciduous forests of Meghalaya. The habitat of *P. tinctorium* was characterized by the presence of surface lime-stone with karst topography. Future investigations should aim at identifying the factors responsible for the restricted distribution of this species so that appropriate conservation measures can be taken.

India, one of the 12 mega-biodiversity countries of the world with approximately 47,000 plant species, is rich in threatened and endemic plants. Although approximately 2000 such species have so far been described from India, many of them are yet to be discovered (Barik *et al.* 2009). The presence of two global biodiversity hotspots in India viz., Eastern Himalayas (part of the Indo-Burma) and Western Ghats, reiterates the need to undertake effective conservation measures for the endemic and threatened plant species in India (Rani 2010). The Khasi Hills region is home to several rare flora and fauna of the country (Rao 1994). Floristically this region acts as a gateway for the migration of flora from the adjacent countries such as China, Japan, Nepal and Bhutan (Chettri *et al.* 2009).

During the floristic exploration and biodiversity survey in Khasi hills of Meghalaya (Figure 1), we collected an interesting tree specimen belonging to the genus *Pterocymbium* R.Br. After a critical study, the specimen was identified as *Pterocymbium tinctorium* (Blanco) Merr. (Figure 2). The species was searched in 10 km x 10 km grids in the tropical region of Khasi Hills which is about 10,377 sq. km area. Of the total 104 grids, intensive survey was undertaken in the forested grids only in a systematic way by subdividing each of these 21 forested grids into one hundred 1 km x 1 km subgrids. We could locate only one population of the species in Shella region with 6 trees, and the total area of occurrence was approximately one hectare. The habitat of this population was characterized by the presence of surface lime-stone and karst topography. The main features of karst topography are limestone terrain, and the absence of surface water flow. Another isolated individual was located at Ranikor, which was located about 55 km from Shella population. Shella and Ranikor have tropical moist deciduous forest with an elevation range of 350-400 m above sea level from where the species was discovered.

Following Bayer (1999), the genus *Pterocymbium* R.Br. was put under the subfamily Sterculioideae of the family

Malvaceae until recently. However, due to disagreement on the family of the genus, now the genus has been placed under the family Sterculiaceae. This was argued by Schott and Endlicher (1832) long time ago, who placed the genus in the tribe Sterculieae under family Sterculiaceae. The family Sterculiaceae does not have epicalyx, as in Malvaceae. The genus *Pterocymbium* R.Br., in Greek meaning winged-boot (a clumsy description of the elegant clawed fruit) comprises of 6 species globally, viz. *P. oceanicum* A.C. Sm., *P. tubulatum* Pierre, *P. nicobaricum* Didr., *P. beccarii* K. Schum, *P. tinctorium* Merr., and *P. javanicum* R. Br. (Anonymous 2011). The keys for identification of these species based on the available taxonomic descriptions are presented below:

- 1a.** Trees more than 60 m high, leaves occurring single at a node and arranged spirally, flowers blue. ***P. beccarii***
- 1b.** Trees less than 50 m high, leaves not as above, flowers other than blue. **2**
- 2a.** Calyx yellow-green without red-brown within. ***P. oceanicum***
- 2b.** Calyx yellow-green with red-brown within. **3**
- 3a.** Seed only 1 at base of each follicle. ***P. tinctorium***
- 3b.** Seeds 2 at base of each follicle. **4**
- 4a.** Winged nut more than 1.0 cm diameter. .. ***P. tubulatum***
- 4b.** Winged nut less than 1.0 cm diameter. **5**
- 5a.** Leaves lobed, petioles 0.5-0.6 cm long. ... ***P. nicobaricum***
- 5b.** Leaves not lobed, petioles 0.7-1.3 cm long. ***P. javanicum***

All the six species of the genus *Pterocymbium* R.Br. are restricted to Philippines, Java, Myanmar, and India in Southeast Asia (Table 1). Although it has been reported that the genus is restricted only to these countries (Anonymous 2008, Anonymous 2011a, Hooker 1872, Prasad *et al.* 2007, Tripathi *et al.* 2004, Sharief and Rao 2007 and Sivarajan *et al.* 1991), no specific location of occurrence is mentioned in the literature.

In India, the genus is represented by two species viz., *P.*

TABLE 1. Country of occurrence of six species of *Pterocymbium*.

SPECIES	COUNTRY OF OCCURRENCE
<i>Pterocymbium oceanicum</i> A.C. Sm.	Endemic to Fiji
<i>Pterocymbium tubulatum</i> Pierre	Peninsular Malaysia, Sumatra, Borneo
<i>Pterocymbium nicobaricum</i> Didr.	Endemic to Great Nicobar Islands in India
<i>Pterocymbium beccari</i> K. Schum	Borneo, Milne Bay , New Britain, Malaysia, Myanmar
<i>Pterocymbium tinctorium</i> Merr.	Meghalaya (present study), North Andaman, and Great Nicobar islands of India, Myanmar, Malaysia, Philip-pines, Thailand, Java, Vietnam
<i>Pterocymbium javanicum</i> R. Br.	Java

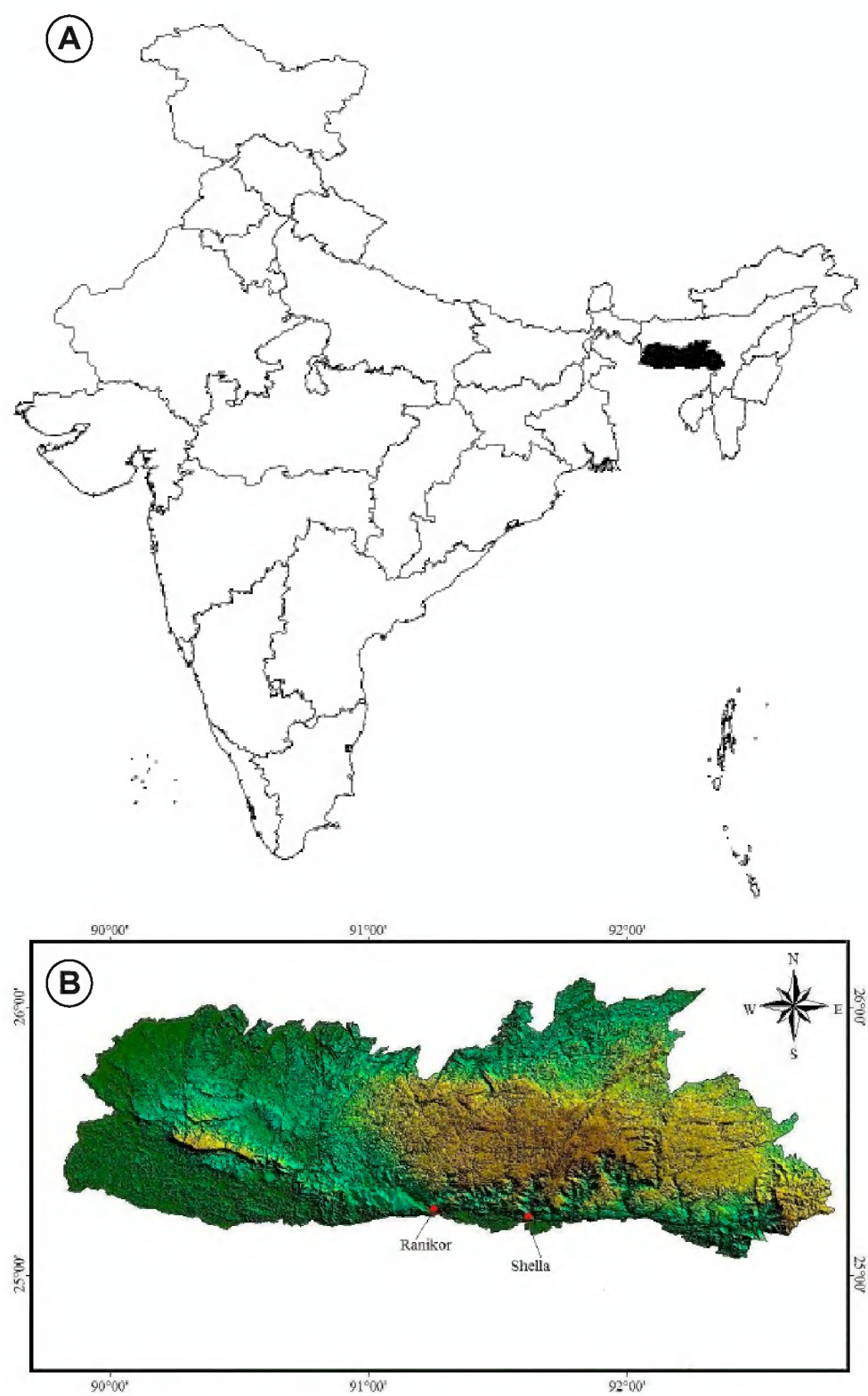


FIGURE 1. (A) Map of India showing location of Meghalaya, (B) Occurrence areas of *Pterocymbium tinctorium* in the state of Meghalaya (the expanded area).

nicobaricum and *P. tinctorium*, which were reported only from Andaman and Nicobar Islands (Prasad *et al.* 2007, Tripathi *et al.* 2004, Sharief and Rao 2007 and Sivarajan *et al.* 1991). This genus is similar to the genus *Scaphium* Schott & Endl., of the same family, but differs in having thin papery leaves which become black after drying. The leaf margin in *Pterocymbium* is entire throughout its life i.e. from seedling to adult. However, in *Scaphium*, the leaf margin is serrated during adult stage. The size of the calyx in *Pterocymbium* is much larger than in *Scaphium*, and the seeds do not exude a gelatinous mass as in *Scaphium*. Both the genera have winged seeds and each seed has one wing. The wings are papery thin and help in seed dispersal. In *Pterocymbium*, the seed is firmly attached to the wing at

the base which remains for long time and is also covered partially by the wing, while in *Scaphium*, it is loosely attached and gets detached easily. The boot-shaped wing of *Pterocymbium* has a nose-like extension at the base that helps in seed dispersal. These wing characteristics and basal position of seed make the seeds of *Pterocymbium* remarkably good fliers. The seeds exhibit helicopter-like motion while falling from the tree (Table 2).

Pterocymbium tinctorium has not been reported by any worker from the Indian mainland. We collected this species from the Khasi Hills (25°11'49.9" N, 91°36'53.5" E; 25°11'48.7" N, 91°37'29.2" E; Figure 1) during a floristic study in the year 2010-11. The examined specimens of *P. tinctorium* (B Singh *et al.* 11903) were processed following standard herbarium techniques (Jain and Rao 1977). The herbaria were prepared and deposited in ASSAM herbarium at Botanical Survey of India and in the University herbarium (NEHU).

The distance between the locations of the earlier reported population of *P. tinctorium* in North Andaman island and Shella-Ranikor population as reported in the present study in Meghalaya, is approximately 2400 km. Andaman islands and Meghalaya are geographically isolated by Bay of Bengal and a hinterland of more than 1000 km, thereby excluding the possibility of these two widely separated populations to be a part of the same metapopulation. Therefore, in the present study, the report of *P. tinctorium* in the state of Meghalaya is a new record to the mainland India.

Examined material: The specimens collected from the field were compared with the housed herbarium at the *Central National Herbarium* (CAL): INDIA, Andaman & Nicobar Islands, North Andaman, Saddle Peak National Park, Paget Island, 560 m, CS Reddy 2018 (CAL).

The specimen was earlier, collected only from Andaman and Nicobar Islands. Thus, the two new records in the present study expand the geographic distribution currently known for this species, and contribute to the knowledge of the tree flora of the Southeast Asia. The taxonomic description of the species could not be traced. The species has also not been classified from a threat perspective. Therefore, we provide below the detailed taxonomic description, photographs, location map and threat classification of the recorded species.

Taxonomic Information

Pterocymbium tinctorium (Blanco) Merr. in Bur. Govt. Lab. Publ. (Philippine Isls.) 27: 24. 1901 (Basionym(s) and Synonym(s): *Heritiera tinctoria* Blanco, Fl. Filip. 653. 1837; *Sterculia campanulata* Wall. ex Mast. in Hook.f., Fl.

TABLE 2. Comparison of diagnostic characters of the genera *Scaphium* and *Pterocymbium*.

PLANT PART	<i>Pterocymbium</i> R.Br.	<i>Scaphium</i> Schott and Endl.
Leaves	Thin papery, becomes black after drying	not papery, becomes brownish after drying
Leaf margin	Entire throughout the life cycle	Serrate during adult stage and entire during seedling stage
Flower	Diameter range: 0.8-1.2 cm	Diameter range:0.5-0.9 cm
Fruits	Spur attached to the boot-shaped follicle	Lacks spur. Only boot-shaped follicle
Calyx	Length ranges from 0.6-0.9	Length ranges from 0.3-0.5
Seed	Firmly attached to the wing and remains at the base for long time,	Loosely attached and gets detached easily and immediately after fall,
Seed wall	Mucilage cell absent, no gelatinous mass recorded	Mucilage cells exude gelatinous mass



FIGURE 2. (A) Habit of *Pterocymbium tinctorium* (Blanco) Merr. in the month of May, (B) Trunk of the tree, (C) Boot-shaped winged fruits/follicles.

Brit. India 1: 362. 1874. *Pterocymbium columnare* Pierre, Fl. For. Cochinch. T. 195. 1889) (Figure 2).

A large deciduous tree, 30-42 m tall; buttress absent; stem 70-85 cm diameter, tapering, no branches for more than half its length, looks white from far; outer bark grey, usually smooth or with small horizontal ridges, finely fissured vertically; inner bark brown red, laminate; sapwood slightly pinkish to white; terminal branches smooth to striate, lenticels absent. *Petiole* brown, 2-8 cm long, glabrous; stipules caduceous. *Leaves* spirally arranged; lamina thinly papery, cordate to ovate, base cordate to truncate, apex acute to acuminate, 7-13.5 × 4-6 cm, glabrous above, pilose below, with 5-7 palmate basal veins, shiny, margin entire, midrib raised; young ones usually lobed, dark green, densely pubescent. *Inflorescence* a lax, erect, terminal panicle, 5-12 cm long, with dense stellate hairs. *Flower* unisexual, with male and female flowers on the same plant stalked, in clusters of 3-5, bell-shaped, 5-lobed; bract caduceous to semi-persistent, outer surface with stellate hairs, inner surface glabrous; *male flower*: not seen; *female flowers*: yellowish white, 5-lobed. *Fruit* of 4-6 follicles, within a persistent calyx, pendulous,

dehiscing before ripening; follicle papery, winged, boat-shaped, 6-9.2 cm long, inner surface of wing glabrous with some red dots, outer surface glabrous or with very sparse stellate hairs, inner surface shiny, outer surface look dull, with a prominent dorsal lobe. *Seed* 1 at base of each follicle, solitary, ellipsoid, 1.5-1.8 × 1.1-1.2 cm, outer surface rough, wrinkled, cotyledon 2, pale yellow, and smooth, between the two a yellow wooly substance is interposed.

Flowering and Fruiting period: Flowering: February-March; Fruiting: April-May.

Habitat: Grows in tropical moist deciduous forests up to an elevation of 400 m, prefers lime stone dominated surface with karst topography.

Associated species: Associated tree species are *Tetrameles nudiflora* R.Br., *Actephila excelsa* Muell. Arg., *Ficus rumphii* Blume, *Heritiera acuminata* Wall. ex Voigt and *Alseodaphne obovata* Kosterm.

Distribution: India (North Andaman Islands (Prasad et al. 2007), Great Nicobar Islands (Sharief and Rao, 2007) and Meghalaya (present study); Myanmar, Malaysia, Philippines and Thailand (Anonymous 2011), Java in Indonesia (Hooker 1872), and Vietnam (Anonymous

2011a).

Species Accounts

Previous record from South-East Asia excluding India: Anonymous (2011a, b) and Hooker (1872).

Previous record from India (Andamans and Nicobar Islands): Anonymous (2008), Prasad *et al.* (2007), Tripathi *et al.* (2004), Sharief and Rao (2007) and Sivarajan *et al.* (1991).

New record locality from mainland India: Present work (Acronym and Accession No. NEHU-11903, 7 May, 2011, from East Khasi Hills district of Meghalaya, Cherrapunjee, Shella, 357 m a.s.l. (25°11'49.9" N, 91°36'53.5" E; 25°11'48.7" N, 91°37'29.2" E).

Status: We classified the species based on population size and the extent of occurrence and distribution, and following the IUCN/SSC Regional Applications Working Group guidelines (IUCN 2003) and criteria of IUCN

(2001) (categories & criteria Version 3.1). The species was categorized as “Critically endangered” (CR A2ab(ii, v); B3bc) (Table 3).

Remarks: The collection of the species from the foot hills of Eastern Himalayas extended the geographical distribution of the species. The habitats of the species are increasingly exposed to disturbance due to the limestone and coal mining activities in nearby areas. Forest fragmentation due to felling of trees for timber and mining is the major cause of the habitat destruction of the species. In view of high intensity of disturbance to its natural habitat, the species might be extinct in the near future, unless adequate conservation measures for the species are taken. Therefore, future research on *Pterocymbium tinctorium* should focus on identifying the reasons for its restricted distribution and efforts must be made to multiply its numbers to increase its population size.

TABLE 3. Population data for *Pterocymbium tinctorium* used for classification of the species under threatened category following IUCN/SSC Regional Applications Working Group guidelines (2003) and IUCN, version 3.1 (2001).

A. Geographic range	2) Area of occupancy (< 10 km ²)
	a) Several fragmented, 2 location
	b) Continuing decline
	ii) Area of occupancy: 100 m ²
B. Population size	v) Number of mature individuals: 3-5
	3) ≤ 8-10 % decline per generation
	b) Density per 10 m ² : 1 individual
	c) Quality of habitat: Fragmented, karst topography, limestone and coal mining.

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LITERATURE CITED

Anonymous. 2008. *Special habitats and Threatened Plants of India-ENVIS*, Wildlife and Protected areas. Dehradun: Wildlife Institute of India. p. 239.

Anonymous. 2011. Partial synonyms of *Pterocymbium*. <http://www.malvaceae.info/Synonymy/Synonymy.php?genus=Pterocymbium/>. Captured on 10 May 2011.

Anonymous. 2011a. Global Biodiversity information facility. [http://secretariat.mirror.gbif.org/occurrences/searchCountries.htm?c\[0\].s=20&c\[0\].p=0&c\[0\].o=15870431/](http://secretariat.mirror.gbif.org/occurrences/searchCountries.htm?c[0].s=20&c[0].p=0&c[0].o=15870431/). Captured on 11 May 2011.

Anonymous. 2011b. Asean Tropical Plant Database. http://211.114.21.20/tropicalplant/html/search01_view.jsp?rno=164&fno=&page=3&all=1/. Captured on 9 May 2011.

Barik, S.K., N.J. Lakadong, R. Baishya, A. Chettri, P. Das, H. Kayang and D. Marbaniang. 2009. A new record of *Monotropa hypopithys* L., A myco-heterotrophic plant from India. *Journal of Bombay Natural History Society* 106 (1): 127-129.

Bayer, C., M.F. Fay, P.Y. de Bruijn, V. Savolainen, C.M. Morton, K. Kubitzki, W.S. Alverson and M.W. Chase. 1999. Support for an expanded family concept of Malvaceae within a recircumscribed order Malvales: a combined analysis of plastid atpB and rbcL DNA sequences. *Botanical Journal of Linnaean Society* 129(4): 267-303.

Chettri, A., S.K. Barik, M.K. Lyngdoh and H.N. Pandey. 2009. Plantae, Magnoliophyta, Gentianales, Apocynaceae, Asclepiadoideae, *Ceropegia hookeri*: Distribution and rediscovery in eastern Himalayas, Sikkim, India. *Check List* 5(3): 695-698.

Hooker, J.D. 1872. *Flora of British India*. Volume I. Ranunculaceae to Sapindaceae. London: L. Reeve & Co. 740 p.

IUCN 2003. *Guidelines for Application of IUCN Criteria at Regional Levels. Version 3.0*. IUCN

Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii+26 pp.

Jain, S.K. and R.R. Rao. 1977. *A Handbook of Field and Herbarium Methods*. New Delhi: Today & Tomorrow's Printers and Publishers. 37 p.

Prasad, P.R.C., C.S. Reddy and C.B.S. Dutt. 2007. Phytodiversity assessment of tropical rainforest of North Andaman Islands, India. *Research Journal of Forestry* 19(1): 27-39.

Rani, G.R. 2010. Medicinal plants viz a viz indigenous knowledge among the tribals of Pachamalai Hills. *Indian Journal of Traditional Knowledge* 9 (1): 209-215.

Rao, R.R. 1994. *Biodiversity in India-Floristic Aspects*. Dehra Dun: Bishen Singh Mahendra Pal Singh. 315 p.

Schott, H.W. and S.F.L. Endlicher. 1832. *Meletemata Botanica*. Vienna: Caroli Gerold.

Sharief, M.U. and R.R. Rao. 2007. Ethnobotanical studies of Shompens - A critically endangered and degenerating ethnic community in Great Nicobar Island. *Current Science* 93(11): 1623-1628.

Sivarajan, V.V., A.K. Pradeep and S.D. Biju. 1991. *Pterocymbium tinctorium* (Blanco) Merr. var. *javanicum* (R.Br.) Kosterm. (Sterculiaceae): A new introduction to India; p. 5-8 In B.K. Gupta (ed.). *Higher plants of Indian subcontinent*. Volume II. Dehra Dun: Bishen Singh Mahendra Pal Singh.

Tripathi, K.P., S. Tripathi, T. Selven, K. Kumar, K.K. Singh, S. Mehrotra and P. Pushpangadan. 2004. Community structure and species diversity of Saddle peak forests in Andaman Island. *Tropical Ecology* 45(2): 241-250.

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